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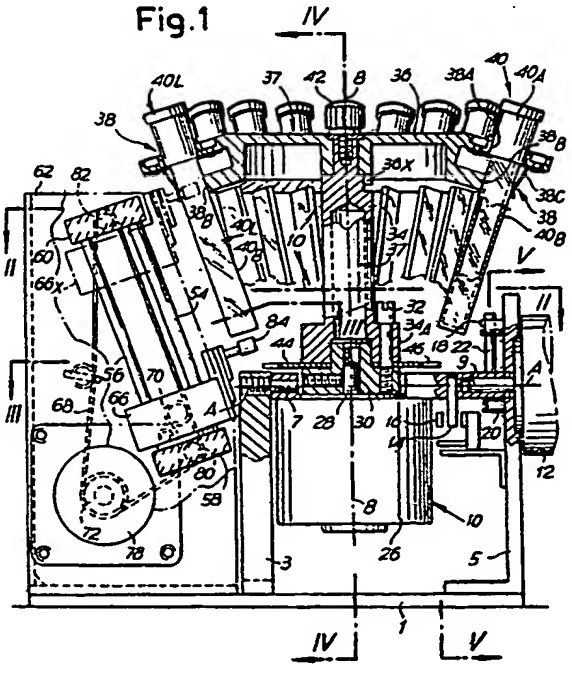
(54) Apparatus for the preparation and execution of tests on the sedimentation rate of organic liquids and others.

(57) The apparatus comprises: a holder (10) oscillating about a horizontal axis (A-A) between two horizontal and vertical positions of the rotation axis (B-B); a rotor (37) able to rotate about a rotation axis orthogonal to said horizontal axis (A-A); on said rotor (37) a crown of seats (38) for test tubes (40) symmetrically distributed around said rotation axis (B-B); and in a reading station reading means (66-84) along the test tube (40L) which reaches said vertical rotor station.

Fig.1



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The object of the invention is an apparatus for the preparation and execution of tests on the sedimentation velocity of previously treated organic liquids which must be stirred within test tube-like containers, such as for the so-called sedimentation rate test and other similar uses.

The purpose of the invention is to provide a simple, reliable apparatus able to quickly carry out the various operation steps. These and other purposes and advantages will be evident by a reading of the following description.

Substantially, the apparatus according to the invention comprises in combination: on a base structure, a holder oscillating about a horizontal axis between two limit positions; on said holder, a rotor able to rotate about a rotation axis orthogonal to said horizontal axis; on said rotor, a crown of seats for test tubes inclined and symmetrically disposed around said rotation axis; and in a reading station, reading means along the test tube that reaches said station by intermittent displacements of said rotor when disposed with its axis upwardly directed. When the holder is in its lowered position there is carried out the phase of stirring the liquids within the test tubes, while when the holder is in its vertical condition the sedimentation measurements are carried out, also reapeted (in kinetic mode), on each test tube.

The apparatus comprises a motor on said oscillating holder to drive the rotor into operation with the rotation axis in substantially horizontal condition for the stirring of the test tubes, and into intermittent operation with the rotation axis in substantially vertical position to bring the test tubes to the reading station in succession. It is not excluded that, with certain inclinations of the test tubes, the sedimentation or decantation be accelerated whenever allowed by the kind of test to be carried out.

The apparatus may comprise a motor for the displacement of the rotor holder between the two positions, with means for the control and stop thereof in the reached positions.

The reading means may comprise guide means for a slide able to slide parallel to the test tube in the reading position; on said slide members being provided for emitting and receiving an optical signal which crosses the test tube during the reading stroke. A suitable motorization - for example with a flexible member driven by wheels and a driving pulley - is provided to cause said slide to perform the reading sweep. The slide may be apt to reach an end-position of the reading stroke and reading cycle of the test tube, in which said emitting and receiving members are placed outside of the trajectory of the test tubes in transit through the reading station.

The test tubes may be advantageously of the type having prismatic and preferably flat walls with their major dimension being placed in the diametral plane of the rotor axis, and the test tubes may be disposed to be engaged within the seats by friction clamps and made to converge towards the axis of rotation with their closed ends, thereby resulting inclined of approximately 18° to the axis of rotation; the oscillating holder is able to reach two positions in which the rotation axis of the rotor is reapectively horizontal for the stirring phase, and vertical for the reading phase.

The apparatus may be combined with a computerized system with a program for performing the operating cycle allowing reapeted readings (in kinematic mode) and the introduction of correction factors for example (and especially) in relation to the temperature of the work environment.

The invention will be better understood by the following description and the attached drawing, which shows a practical, non limiting exemple of the same invention. In the drawing:

Fig. 1 shows a vertical section of the apparatus with the rotor axis in vertical arrangement;

Figs. 2 and 3 show two horizontal sections taken on line II-II and III-III of Fig. 1;

Fig. shows a section on line IV-IV of Fig. 1, with the rotor axis in horizontal arrangement;

Fig. 5 shows a local section on line V-V of Fig. 1.

According to what is illustrated in the attached drawing, numeral 1 indicates a base structure on which two support 3 and 5 are provided for two pivot pins 7 and 9, which are aligned according to on an oscillation axis A-A for a holder 10 oscillating about said horizontal axis A-A. The pin 9 may be represented by the rotation axis of a motor 12 mounted on the support 5 and able to move the holder between two positions orthogonal to each other, which can be detected by suitable detection means, for example comprising an appendix 14 radially extending on the holder 10 orthogonally to the oscillation axis A-A, and optical sights 16 for the control of the position of this appendix 14. Pawls 18 and 20 may also be provided, with which a further appendix 22, also radially projecting with respect to axis A-A of the oscillating holder 10, is able to co-act. The oscillating holder 10 comprises a motor 26 with output shaft having an axis B-B orthogonal to the horizontal oscillation axis A-A of said holder 10. To the output 28 a body 30 is solid, to which a column 34, 34A may be applied by screw 32 or other equivalent means, said column supporting, at the end opposite to the motor 26, a disc or plate 36 provided with seats for housing the test tubes. The members 28, 30, 34, 36 make up a rotor 37 borne by the oscillating holder 10 and making up a substantial portion of such holder. The disc or plate 36 is provided with seats generally indicated by 38, circumferentially distributed about

the B-B axis of the rotor 37. Each seat 38 may consist of a through hole 38A and of a bearing shoulder 38B, facing a pressure spring 38C which stems from a laminar crown engaged around hole 38A. Each test tube 40 may be inserted into the seat 38A, 38B being elastically pressed against shoulder 38B by the relevant spring 38C. The test tubes 40 are advantageously of the type having a head 40A with access opening apt to be closed by a suitable shutter and a lengthwise body which is prismatically developed and has flat cross-section as indicated in 40C, and whose major median is in the diametral plane passing through the axis of the test tube P and through the axis B-B of rotor 37. The axis of each test tube in the above mentioned diametral plane is inclined to the B-B axis at an angle suitable for facilitating the operations to be performed by the apparatus, for example, for facilitating the sedimentation by an inclination in the order of about 18°, which is an inclination apt to accelerate the sedimentation for the assessment of the so-called sedimentation rate of organic liquids. The disc or plate 36 with seats 38 can be readily replaced for various reasons including that of changing the inclination of the test tubes axis with respect to the axis B-B of rotor 37 of the holder 10, and/or for changing the type of test tube to be used for the analysis. For the assembly and disassembly of the disc or plate 36 there may be provided a screw member 42 which is engaged to the end of column 34 to fix the disc or plate thereto at a predetermined position by means, for example, of a datum tooth 36X received into a corresponding seat of column 34.

The holder 37 rotating about the axis B-B, which is also the axis of the step-by-step motor 26, is provided with a disc 44 engaged between the base 34A of column 34 and the body 30 mounted on shaft 28; this disc 44 is provided with slots 46 having a disposition corresponding to that of seats 38 and thus of test tubes 40. One of these slots which extend radially from the edge of disc 44 is deeper than those indicated by 46 and is designated by 48, in order to make up a datum (or reference) for the zero position. The step-by-step motor 26 of the rotor 37 of the holder 10 (and through it, the position of rotor 37) is controlled by detecting of slots 46 and slot 48 by means of the optical sights 50 and 52, the first controlling all the slots 46 and the slot 48, while the sight 52 controls only the slot 48 to indicate the zero position of rotor 37.

As can be seen from the drawing, the test tubes are symmetrically inclined with respect to the axis B-B of rotor 37, the ends of the prismatic bodies 40 converging towards said axis B-B.

In a side position with respect to the rotor unit there is provided a station for the reading of a test tube which takes up the position 40L when it is placed in said reading station. In correspondence of the reading station there is a reading system along the body 40B of the test tube located at position 40L.

To carry out the above mentioned reading, which is an optical reading across the body 40B of the test tube at position 40L, there is provide a mobile slide parallel to the development of body 40B of said test tube in position 40L. To achieve this, a guide system is provided comprising two guide stems 54 and 56 extending between two connection bodies 58 and 60 fixed to a square bracket 62 engaged to the base 1. On the guide means represented by the stems 54 and 56 is made to slide a slide 66 which can be displaced by means of a flexible cable 68 anchored by a clamp 70 to the slide 66 and wound with several turns over a drum 72 formed by a body 74 solid to the shaft 76 of a motor 78 fixed to the square bracket 62. The flexible cable 68 is suitably driven by pulleys 80 and 82 borne by supports 58 and 60; in this way, by means of motor 78 it is possible to cause the slide 66 to perform reciprocating travels onto the guides 54 and 56. In the side view (Fig. 1), the slide 66 is shown at the lower travel end with solid line and at the upper travel end with broken line and reference 66X. The slide 66 carries two terminal 84, 86 facing each other which make up the emitting and receiving means for an optical signal which crosses the body 40B of the test tube at the reading position 40L, during the travels of slide 66. When the slide is at the lower position shown with solid line in Fig. 1, the two terminals 84, 85 are placed below the body 40B of the test tube located at 40L, so that they do not interfere with this test tube nor with all the other test tubes when the rotor 37 rotates around the axis B-B to bring the test tubes in succession to the reading position 40L. On the square support 62 there may be placed a group 86 making up a sensor for detecting of the position of slide 66 which, to this end, is provided with a projection 88 able to transit between the two sight lugs of group 86.

The operation of the apparatus is as follows. In order to load the test tubes, the holder 10 is disposed with its axis B-B in vertical position to allow the insertion of the test tubes into the seats 38 with the head 40A turned upwards. The work cycle is then started and motor 12 rotates to bring the holder 10 with its axis B-B into horizontal position, then the motor 26 is actuated to start the rotation of rotor 37 and thus determining the stirring of test tubes 40:, these, by rotating about the axis B-B horizontally disposed, are made to perform a cyclic oscillating and rotating movement which causes the uniform stirring of all the liquids contained in the test tubes 40. The holder 10 is

then made to rotate about the axis A-A to bring the holder 10 back with the rotor axis B-B in vertical position and then start the sedimentation phase which owing to a phenomenon well known to those skilled in the art is accelerated due to the fact that the test tubes are inclined to the vertical. In certain cases, and possibly with test tubes disposed, for example, with an upwards and outwards inclination (by replacing the disc or plate 36 and providing a suitable different positioning of the reading system), an effect may be caused similar to the one previously described. At the end of a sedimentation period it is possible to perform a reading or, during the sedimentation phase, there may be performed a series of readings in kinetic mode, to assess the sedimentation degree of liquids held in the test tubes. To achieve this, the rotor 37 is made to rotate intermittently through motor 26 (which may be of step-by-step type), thereby causing the test tubes 40 to reach in succession the reading position 40L, the slide 66 being, during each displacement, with its terminals 84, 85 in the lower position to avoid any interference with the test tubes. Upon each stop of motor 26, and thus when the next test tube reaches position 40L, the motor 78 causes the slide 66 to perform a lifting travel and then a lowering travel, from position 66 to position 66X and back again to position 66 respectively, to cause a reading through terminals 84, 85 and across the body 40B of the next test tube at position 40L, thereby assessing the transparency, during the displacements, by means of data suitably processed and stored in memory. The readings of the various test tubes can be made in very short times. Since it is possible to repeat more cyclic readings in sequence for all the test tubes and thus obtaining repeated readings on each test tube, there may be obtained reading data in kinetic mode, this being particularly advantageous for certain results in the research on the sedimentations of organic liquids.

The apparatus may be associated to a computerized unit for the computation, storing and then printing of the obtained data, which unit may be driven by systems for the control of data from the individual test tubes by utilizing signals obtainable through slots 46 and the zero slot 48, in order to obtain a safe classification of the various data achieved from the single test tubes. To the computerization unit there may also be combined a unit for the correction of data, to account for the temperatures of the environment in which the apparatus operates, without thereby any need for air conditioning of the same environment and thereby reaching a high accuracy with no influence from the sudden changes of temperature the environment may be exposed to.

Claims

1. Apparatus for the preparation and the execution of sedimentation rates tests in organic liquid previously treated and which must be stirred in test tube-like containers, characterized by comprising in combination: on a base structure (1-5-62) a holder (10) oscillating about a horizontal axis (A-A) between two limit positions; on said holder (10) a rotor (37) able to rotate about an axis of rotation (B-B) orthogonal to said horizontal axis (A-A); on said rotor (37) a crown of seats (38) for test tubes (40), each one being symmetrically disposed and oriented around said axis of rotation (B-B) with an inclination with respect to said axis of rotation, in the relevant diametral plane; and, within a reading station (40L) reading means (66-84) along the test tube which reaches said station by intermittent displacements of said rotor (37) when disposed with its axis upwardly oriented.

2. Apparatus according to the preceding claim, characterized by comprising on the holder (10) a motor (26) for the actuation of the rotor (37) with the rotation axis in substantially horizontal position for the stirring of the test tubes and for the intermittent actuation of the rotor with the rotation axis in substantially vertical position in order at least to bring the test tubes in succession into the reading station (40L).

3. Apparatus according to the preceding claims, characterized by comprising a motor (12) for the displacement of the holder (10) of the rotor (37) between the two positions, with means for stopping and controlling the reached positions.

4. Apparatus according to the preceding claims, characterized in that the reading means (66-84) comprise guide means (54) for a slide (66) able to slide parallel to the test tube (40L) when the latter is in the reading position, on said slide (66) emitting and receiving means (84-85) for an optical-type signal which crosses the test tube during the reading stroke, and a motorization (78, 68) for the displacements of said slide.

5. Apparatus according to the preceding claims, characterized in that said motorization (78, 68) comprises a flexible member (68) driven by wheels (80, 82) and by a driving pulley (72), to cause said slide (66) to perform the reading travel.

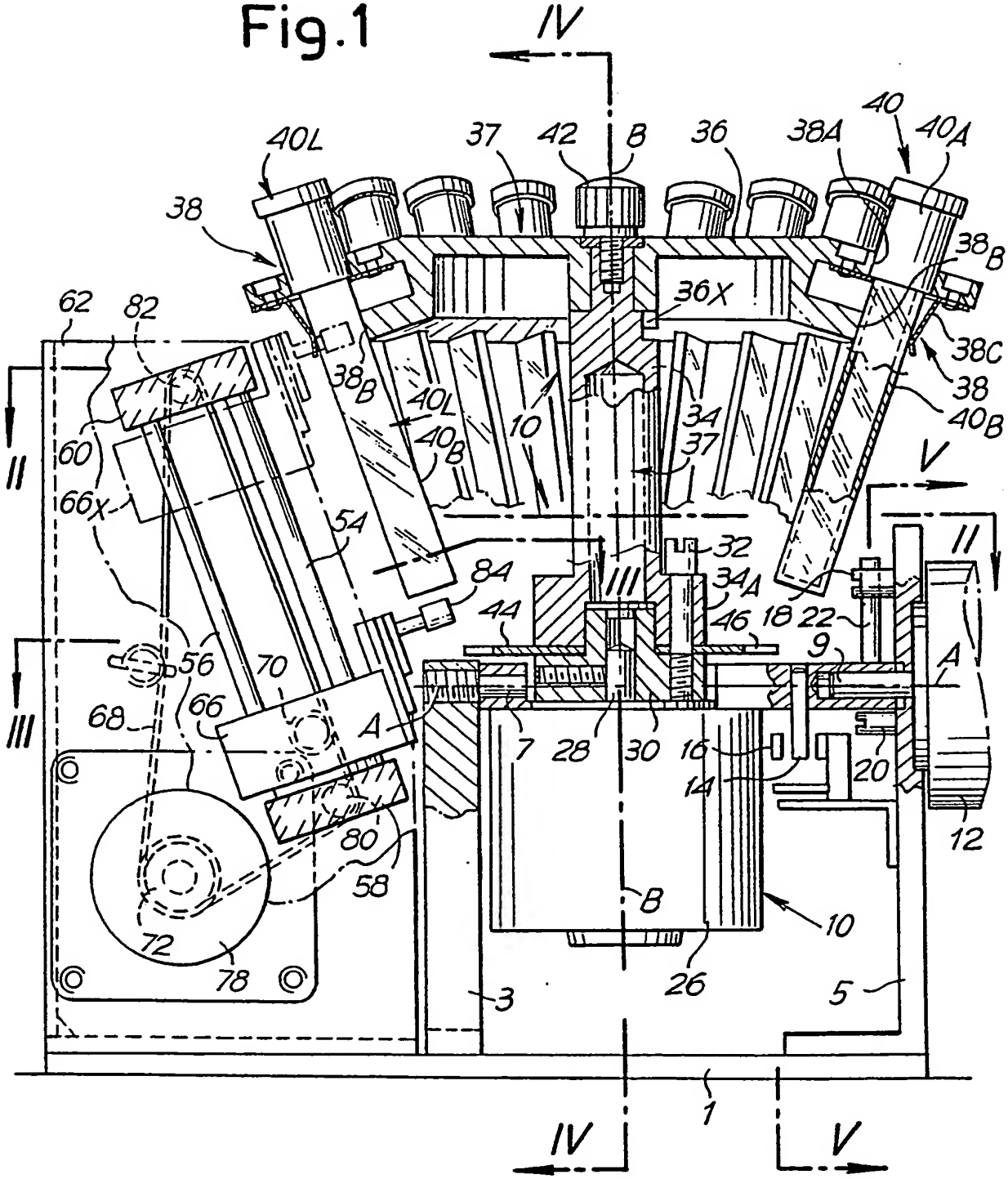
6. Apparatus according to claim 4 or 5, characterized in that the slide (66) is able to reach an end position of the travel- and reading cycle of a test tube, in which said emitting and receiving means (84, 85) are outside the trajectory of the test tubes in transit through the reading station.

7. Apparatus according to the preceding claims, characterized in that: the test tubes (40) are so disposed as to be engaged within the seats (38) of the rotor (37) with friction clamps (38C) and to

converge towards the rotation axis (B-B) with closed ends being inclined of about 18° to the rotation axis; and that the oscillating holder (10) is able to reach two positions in which the rotation axis (B-B) of the rotor (37) is respectively horizontal for the stirring phase, and vertical for the reading phase.

8. Apparatus according to the preceding claims, characterized by comprising a computerized system (90-92) for the programming of the operative cycle, with the possibility of performing readings in kinetic mode and of introducing correction factors to account for temperature changes and other.

Fig.1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37
42
B
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38A
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40A
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38B
36X
62
82
38C
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40B
60
66X
54
10
34
37
V
II
32
84
III
34A
44
46
18
22
9
A
56
70
68
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IV
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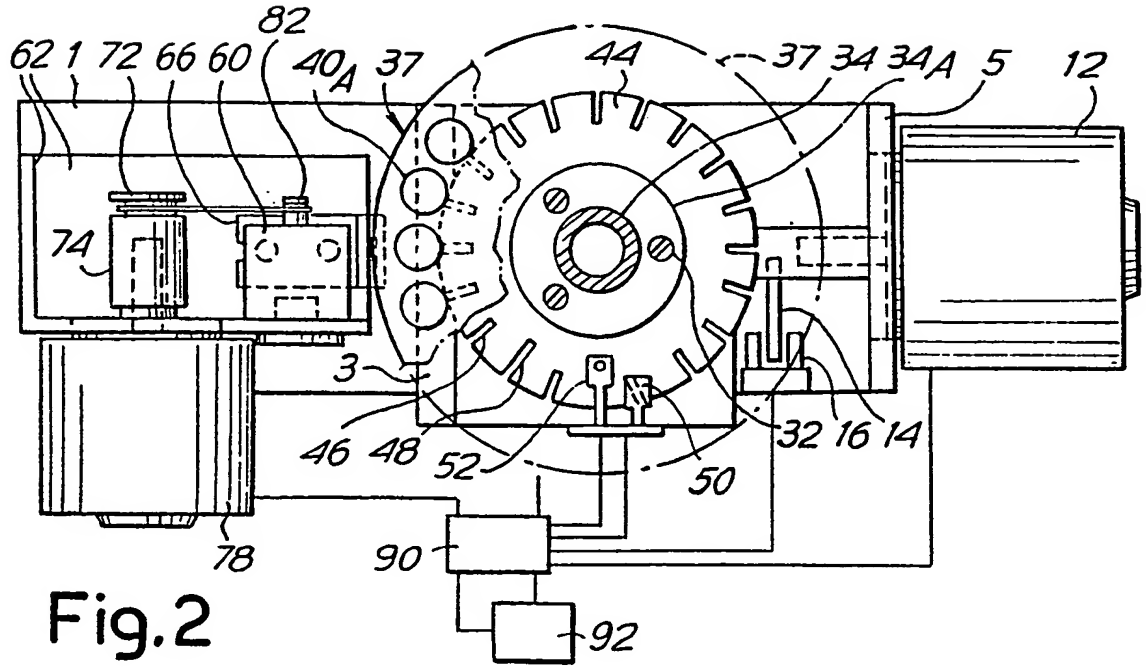
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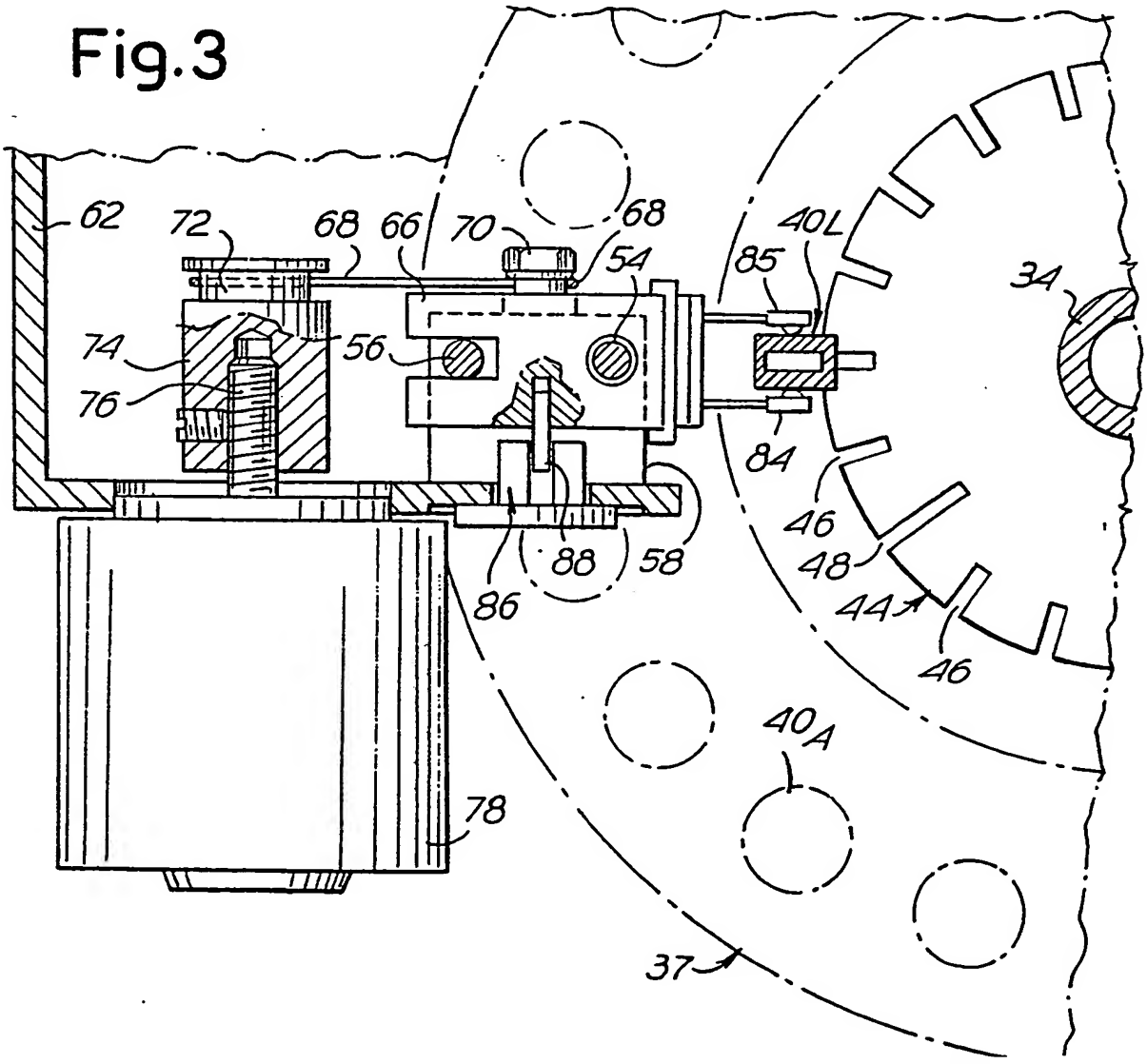
92

Fig.2

Fig.3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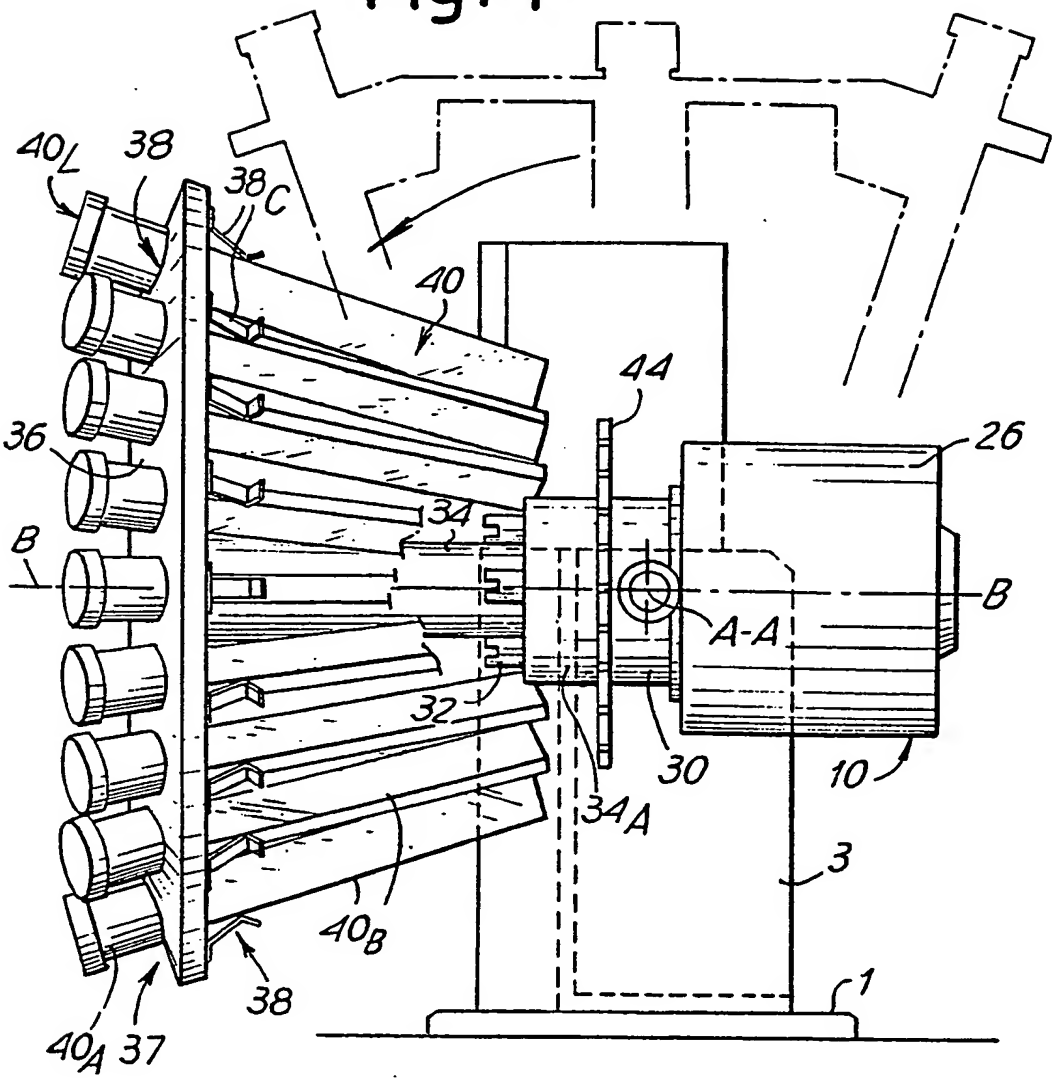
86
40A
78
37

Fig. 4


40L
38
38C
40
44
26
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A-A
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10
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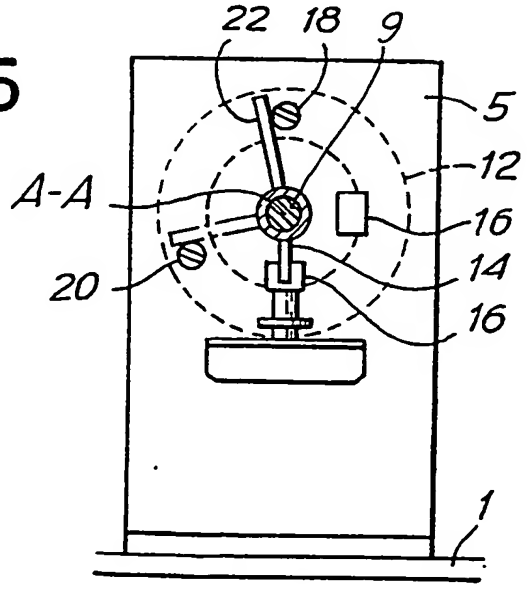
38
40A
37

Fig. 5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1

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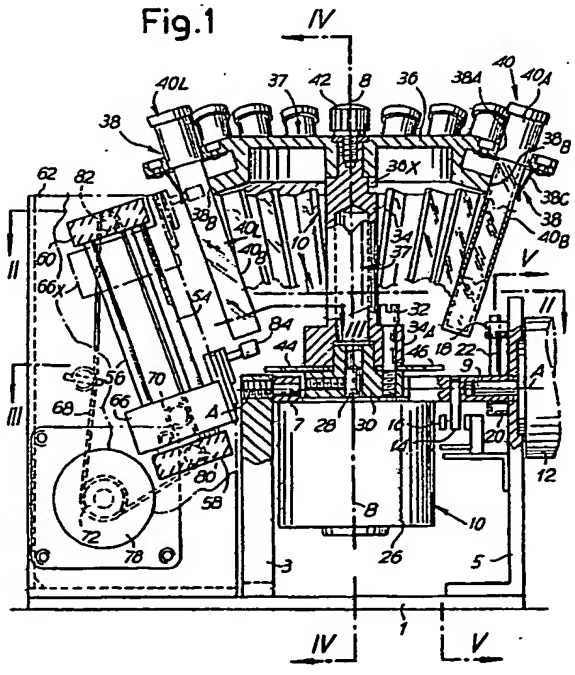
Fig.1



EP 0 391 861 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 83 0094

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-3 980 227 (WITTY et al.) * Column 1, lines 5-34 *	1,2	G 01 N 15/04
A	EP-A-0 102 764 (DIESSE DIAGNOSTICA) * Page 6, line 8 - page 8, line 15; pae 10, lines 17-20 *	1,8	
A	EP-A-0 142 422 (CNRS) * Page 4, line 13 - page 5, line 3; page 7, lines 16-22; figure 6 *	4-6	
A	FR-A-2 561 776 (UNIVERSITE DE RENNES) * Figure 1; page 14, line 5 - page 15, line 1 *	4,5	
A	US-A-4 168 233 (ANDERSON) * Column 3, lines 13-61 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 01 F 9/00
B 04 B 5/00
G 01 N 15/00

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	15 March 91	BINDON C.A.

CATEGORY OF CITED DOCUMENTS

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